APPLICATION

OF

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ON

IMPROVED ELECTRICAL CONNECTOR FOR AIRCRAFT FUEL PUMPS

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IMPROVED ELECTRICAL CONNECTOR FOR AIRCRAFT FUEL PUMPS

BACKGROUND OF THE INVENTION

This invention relates generally to electrical control systems, and more specifically relates to an electrical connector for aircraft fuel pumps.

A conventional electrical connector 10 for aircraft fuel pumps is illustrated in Fig. 1. The electrical connector includes a cup-shaped connector shell 12 with an outer radial connector flange 14 approximately 0.080 inch thick, and a glass electrical insulating plug 16 mounted in the cup-shaped connector shell. A plurality of connector pins 18 are mounted in the glass insulating plug, each having a portion 20 extending from the glass insulating plug and covered by potting 22, such as an epoxy resin potting compound, for example. Electrical cables (not shown) would also extend through the potting to the individual connector pins.

In aircraft, electrical arcing in the presence of a fuel leak can lead to disastrous results. Airworthiness Directive (AD 97-03-17) issued following reports of fuel leaks at the fuel boost and override/jettison pumps, and electrical arcing that occurred on JAL 747 aircraft, which resulted from formation of a conductive layer between potting of the connector and electrical insulation glass of the connector. The conductive layer provided an electrical path for arcing to occur between connector pins, or between one or more connector pins and the casing of the connector, which was severe enough to burn through the connector shell, allowing fuel to leak to the environmental side of the fuel pump. The potting of the connector formed an imperfect seal with the connector, and contributed to the severity of the arcing condition by allowing contamination to become trapped in the connector, which initiated arcing. In addition, the potting of the connector contained the arcing event, allowing extreme heat and pressure

to build up. Subsequent carbonization of the potting provided a conductive path for the arc and provided additional material to sustain the arcing reaction which could burn through surrounding material to permit a fuel leak to occur.

It would therefore be desirable to provide an improved, non-potted open design for an electrical connector for aircraft fuel pumps, allowing potential contaminants to escape or be removed from the electrical connector. It would also be desirable to provide an improved electrical connector for aircraft fuel pumps with an improved glass hermetic seal, connector flange and electrical insulating risers to provide electrical insulation and an increased current leakage path between each pin of the connector and between the connector pins and the connector housing. It would also be desirable to provide strain relief and improved electrical insulation of the electrical connector. There, thus exists a need for an improved electrical connector for fuel pumps, particularly for aircraft. The present invention addresses these and other concerns.

SUMMARY OF THE INVENTION

Briefly, and in general terms, the present invention provides for an improved electrical connector for aircraft fuel pumps. The improved electrical connector has a non-potted, open design, allowing potential contaminants to escape or be removed from the electrical connector, and includes thickened glass hermetic seal and connector flange portions, electrical insulating risers providing an increased current leakage path between connector pins and between the connector pins and the connector housing, and improved strain relief and electrical insulation extending over a portion of electrical cables connected to the connector pins and risers of the electrical connector.

The present invention according provides for an improved electrical connector for aircraft fuel pumps. The improved electrical connector includes a

cup-shaped connector shell or housing, having opposing first and second ends, the first end being closed and the second end being open, and an outer radial connector flange at the first end. The cup-shaped connector shell is preferably formed as a one piece, unitary connector shell, and may be formed of stainless steel, or a corrosion resistant steel, for example. The cup-shaped connector shell is also preferably configured to increase the distance between connector pins and grounded portions of the connector shell to thus increase the length of any potential arcing. A glass electrical insulating plug is mounted in the first end of the cup-shaped connector shell, and forms a hermetic seal of the first end of the cup-shaped connector shell. A plurality of tubular risers are mounted to the glass insulating plug at the first end of the connector shell, with each of the tubular risers having a portion extending from the first end of the connector shell. In a presently preferred embodiment, the tubular risers may be ceramic electrical insulating risers. A plurality of connector pins are mounted in the glass insulating plug and extend longitudinally through corresponding tubular risers, and through the connector shell. In one aspect, each the connector pin includes a solder cup at the first end of the connector shell for receiving a corresponding electrical cable. A plurality of electrical cables are connected to corresponding connector pins, respectively.

In one currently preferred embodiment, at least one outer layer of electrical insulating tubing is provided to cover at least a portion of one or more of the risers, a portion of the connector pins extending from the corresponding tubular risers, and the corresponding electrical cables. In one presently preferred embodiment, the outer layer of electrical insulating tubing may be heat shrunk tubing, such as cross-linked fluoropolymer tubing, and may be formed from two layers of the heat shrunk cross-linked fluoropolymer tubing. Optionally, electrical insulating tubular extension may also be disposed over the outer layer of insulating tubing, the corresponding tubular risers, the corresponding portion of

the connector pins extending from the tubular risers, and the corresponding electrical cables.

These and other aspects and advantages of the invention will become apparent from the following detailed description and the accompanying drawings, which illustrate by way of example the features of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a sectional view of a prior art electrical connector for aircraft fuel pumps.

Fig. 2 is a sectional view of the improved electrical connector of the invention for aircraft fuel pumps.

Fig. 3 is an enlarged view of one of the connector pins of the improved electrical connector of Fig. 2, showing the addition of an optional electrical insulating tubular extension.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

As is illustrated in the drawings, which are provided for the purpose of illustration, but not by way of limitation, the invention is embodied in an electrical connector 30 for aircraft fuel pumps, as is illustrated in Fig. 2. The electrical connector includes a cup-shaped connector shell or housing 32, having opposing first 34 and second 36 ends. The first end 34 is closed and the second end 36 is open for receiving a corresponding connector portion from a fuel pump (not shown). An outer radial connector flange 38 is provided at the first end. The cup-shaped connector shell is typically formed as a one piece, unitary cup-shaped connector shell, and may be formed of a corrosion resistant metal such as stainless steel or corrosion resistant steel, for example. The electrical connector

of the invention is configured to increase the distance between connector pins and grounded portions of the shell, to thus increase the electrical current path of any potential arc. The outer radial connector flange is preferably 0.180 inch thick, which is 0.100 inch thicker than the outer radial connector flange of a conventional electrical connector. A glass electrical insulating plug 40 is mounted in the first end of the cup-shaped connector shell, forming a hermetic seal of the first end of the cup-shaped connector shell, and is preferably 0.065 inch thicker than the glass insulating plug of the conventional electrical connector. A plurality of tubular risers 42 are mounted to the glass insulating plug at the first end of the connector shell, each having a portion 44 extending from the first end of the connector shell. The tubular risers are typically constructed of an electrical insulating ceramic material, such as the machinable glass ceramic available from Corning under the trade name "MACOR."

A plurality of connector pins 46 are mounted in apertures 48 of the glass insulating plug, and extend longitudinally through corresponding tubular risers, and through the connector shell. Each of the connector pins includes a portion 50 that extends from the corresponding tubular riser at the first end of the connector shell, with a solder cup 52 located at the first end of the connector shell for receiving a corresponding electrical cable 54. A plurality of electrically insulated electrical cables 54 are typically connected to corresponding connector pins, respectively. At least one additional outer layer of electrical insulating tubing 56 is provided to cover at least a portion of at least one of the risers extending from the first end of the connector shell, a corresponding one of the portion of the connector pins extending from the corresponding tubular risers at the first end of the connector shell , and a corresponding one of the plurality of electrical cables, to provide additional electrical insulation and strain relief at the connection of the electrical cables to the connector pins. The insulating tubing is typically a heat shrunk tubing, such as a cross-linked fluoropolymer tubing

available from Raychem under the trade name RT-555. Typically two layers of the heat shrunk tubing are provided over each of the connections of the electrical cables to the connector pins and the tubular risers.

Optionally, as is shown in Fig. 3, at least one insulating tubular extension 58 formed of an electrically insulating material such as ceramic, glass, rubber, plastic or the like, may also be disposed over the outer layer of insulating tubing, tubular risers, connector pins and electrical cables.

From the above, it may be seen that the present invention provides benefits over previous aircraft fuel pump electrical connectors and address significant concerns and shortcomings over previous connectors. It will also be apparent from the foregoing, that while particular forms of the invention have been illustrated and described, various modifications can be made without departing from the spirit and scope of the invention. Accordingly, it is not intended that the invention be limited, except as by the appended claims.